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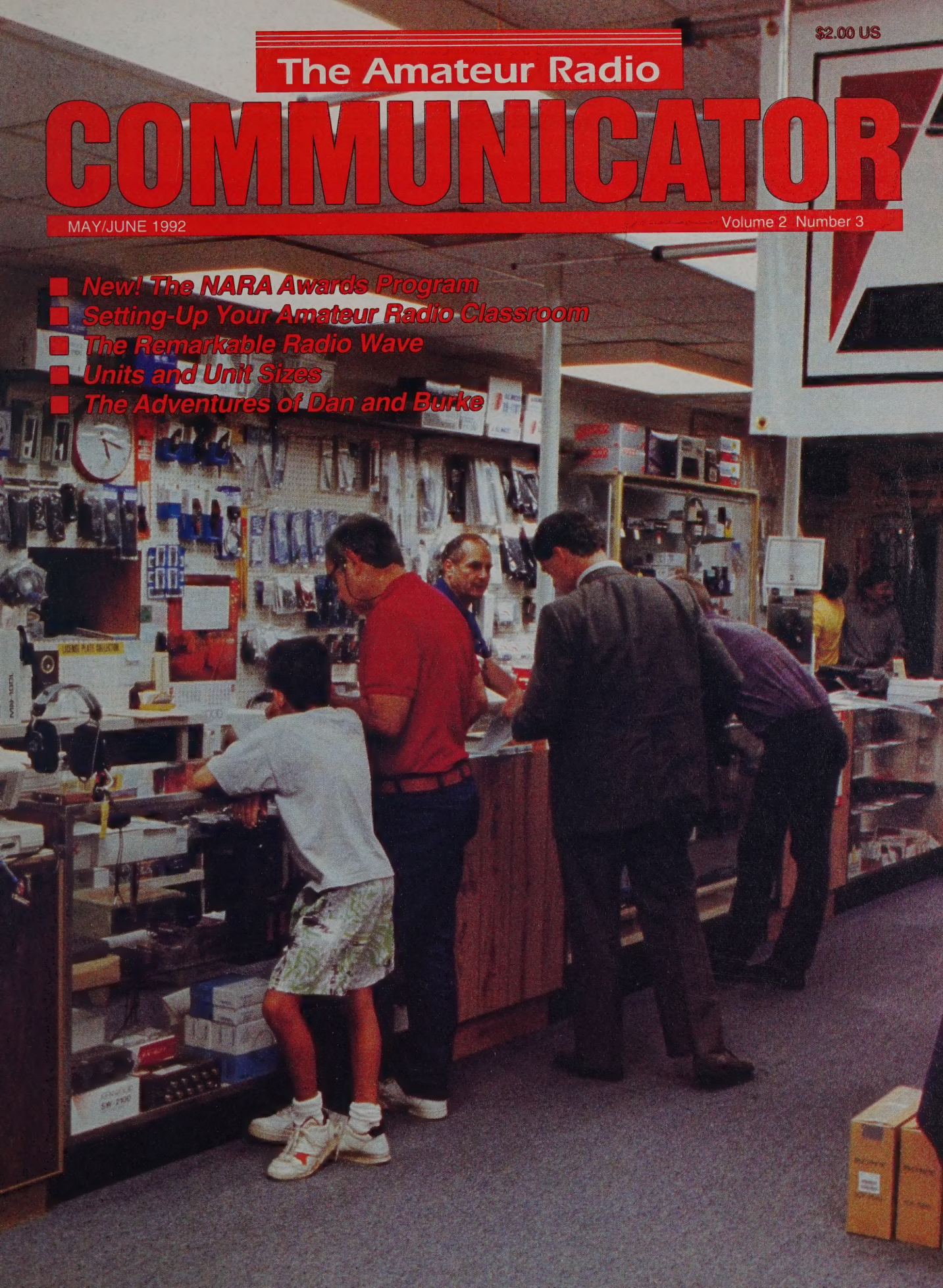
The Amateur Radio COMMUNICATOR

MAY/JUNE 1992

Volume 2 Number 3

- New! The NARA Awards Program
- Setting-Up Your Amateur Radio Classroom
- The Remarkable Radio Wave
- Units and Unit Sizes
- The Adventures of Dan and Burke



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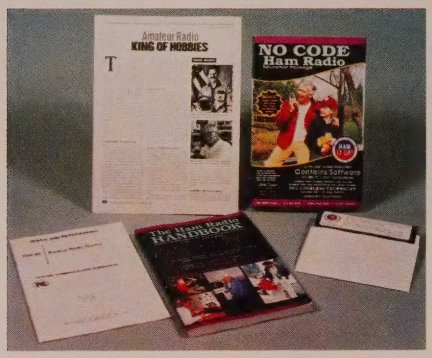

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Attention Ham Dealers and Hobby Store Owners! This publication is a great way to attract people to your business and save valuable staff time by explaining what Amateur Radio is all about. Call today for "one" Free copy!

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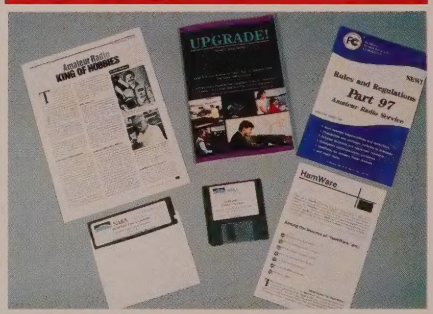

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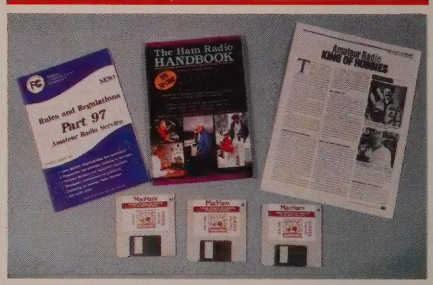
System requirements: *Any Macintosh computer, Mac Plus or newer, 2MB RAM with hard drive and Mac compatible printer. Fully compatible with System 7.0 and 6.0.7; ships with HyperCard 2.1 on two 3½" 800K disks.*



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- An extensive list of Contact Volunteer Examiners

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FEATURES

DEPARTMENTS

ON THE COVER

When was the last time you browsed through your local Amateur radio store and discovered all the new and exciting toys in the Ham-world? You'll find all the parts and equipment you need and plenty of friendly advice from your Amateur radio dealers, such as Electronic Equipment Bank (EEB) in Vienna, Virginia, owned by Dick Robinson, shown on our cover this issue. EEB has a great catalogue and may be reached at 323 Mill St. NE, Vienna, Virginia 22180 or telephone (703) 938-3350. Thanks to EEB for inviting us into their store.

The Amateur Radio Communicator

The Amateur Radio Communicator is published monthly and is the official journal of the National Amateur Radio Association (NARA), P.O. Box 598, Redmond, WA 98073-0598.

The National Amateur Radio Association is incorporated in the State of Washington and is an exempt organization as defined in Section 501(c)(3) of the Internal Revenue Service Code.

Organization Goals

The National Amateur Radio Association is a nonprofit organization. It consists of individuals interested in the art of radio communication. The broad goal of NARA is to make Amateur Radio more widely known and to encourage more people to become involved in the Amateur Radio Service.

The organization has four specific goals within this broad framework. These are to a) publicize Amateur Radio to the general public, b) attract young people to the Amateur Radio Service, c) help existing Amateurs achieve the greatest benefit from the Amateur Radio Service and d) make Amateurs aware that our radio frequencies are in jeopardy from commercial interests.

NARA advertises in various consumer publications to create a public awareness of the Amateur Radio Service and to encourage readers to write NARA for more information. The Association also solicits authors who write on the subject of Amateur Radio in these publications. NARA has committed itself to making Amateur Radio more interesting and more accessible to all concerned.

NARA
NATIONAL AMATEUR RADIO ASSOCIATION
P.O. Box 598
Redmond, WA 98073-0598

NARA is specifically interested in encouraging young people to join our fraternity. The organization works with educators to increase awareness of the Amateur Radio Service and its value as an interesting way of educating young people. A core of young people insures continued growth of the Amateur Radio Service.

NARA believes that existing Amateurs should be more aware of the radio communication theory. Each month an article will appear in *The Amateur Radio Communicator* which discusses a technical aspect of the Amateur Radio Service.

NARA is very concerned that confiscation of frequencies assigned to the Amateur Radio Service will continue. These frequencies are a precious resource. On the other hand, there are an inadequate number of frequencies to accommodate all the new communication requirements. Amateurs must create an environment where it is more beneficial to the public to have Amateur Radio operators on these frequencies than new and emerging commercial services.

Membership and Subscriptions

Those joining NARA receive a subscription to *The Amateur Radio Communicator* for a period of one year. The combined cost of membership and magazine is $10.00 per year in all areas with a U.S. ZIP code.

The NARA membership and subscription to *The Amateur Radio Communicator* cannot be separated. Since NARA is a nonprofit organization, the membership cost may be tax deductible. Verify this with your accountant.

It is not necessary to hold an Amateur Radio license to become a member of the National Amateur Radio Association. The only "qualification" is an interest in radio communications.

Editorial Policy

Each article and column which appears in *The Amateur Radio Communicator* is evaluated by the Editorial Board to meet a single criteria: how it contributes to NARA's educational objectives. Editorial material is intended to either (1) interest new people in becoming a Radio Amateur, (2) help existing Radio Amateurs get more out of their hobby through better understanding, (3) explain the theory behind some aspect of the service or (4) educate Amateurs on how to retain our valuable spectrum.

How To Contact NARA

The editors of *The Amateur Radio Communicator* and officers of the National Amateur Radio Association want to hear from you. Please send your questions, comments or submissions to:

National Amateur Radio Association
P.O. Box 598
Redmond, WA 98073-0598

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	or 1(800)468-2426
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MCI Mailbox	NARANET3
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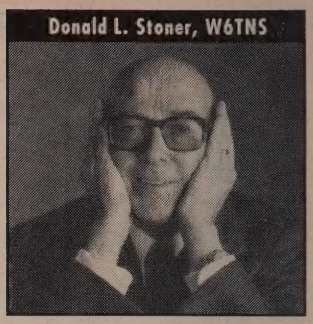

Donald L. Stoner, W6TNS

Technology Can Save Us!

by Don Stoner, W6TNS

ONE OF THE AREAS that Americans really excel in is the creation of new technologies. Without negating the contributions of the other countries, we did (and continue to do) a pretty good number with airplanes, space vehicles and exploration, medical electronics, computers and the creation of new consumer-electronic devices.

Unfortunately, we are equally adept at exporting this technology without any benefit to our nation. The VCR comes to mind as a specific example of our largess in giving away technology. Ampex Corporation discovered and patented the secret of the VCR as we know it—the rotating video head. This gave American companies quite a head start (no pun intended) in the consumer electronics marketplace, but every home entertainment VCR today is imported (in fairness to Ampex, they are big in broadcast recorders—along with SONY.) But that's another story for another day.

This editorial is not about overseas competition. It is about curing some of our socioeconomic problems with technology. In my opinion, technology can do this and more, if we simply take a creative approach to its application.

The Town Hall—I'm not sure what you think about Ross Perot. While this is being written, Mr. Perot is still coy about his intentions as they relate to the electorate. Most will agree that if he runs, the elections this fall could be the most unusual that have ever occurred in the history of our country.

If nothing else, Ross Perot understands the application of technology to the solution of problems. As an example, one of his controversial proposals is the creation of a Town Hall.

In theory, Americans are supposed to keep their elected representatives advised of their needs and wishes as they relate to the laws of this country. In practice, very few ever do so. Most people don't even remember their legislator's name until election time or when mentioned in various scandals. As a result, if your representative receives a few-dozen pieces of independent mail on a given subject, he or she knows that an issue is "cooking" out in the hinterlands. Although millions of people may be represented by this person, receiving a thousand pieces of mail (other than form letters) on an issue is virtually unheard.

Most people don't even remember their legislator's name until election time or when mentioned in various scandals.

Americans are starting to realize that the rights and needs of the community are the most important of all. So how can our legislators create or vote on laws if we don't tell them of our wishes and desires? Among other things, they are not telepathic.

A Town Hall solution has one or more central computers that collect data on the desires of the populace. For example, let's say the government needs guidance on the subject of health care. A question posed to the electorate might be: "Are you willing to pay $500 additional in taxes, in return for a national health care program?" Mr. and Mrs. Jones and their children (old enough to understand the issue and its many ramifications) would discuss the question and come to a family consensus. They would then dial a local no-charge number and register their position by using the touch-tone pad input.

The nay-sayers can find many things wrong with the concept. However, just because some people make "rolling stops" at those red-hexagonal signs doesn't mean they should not be installed.

Worried about selling your opinion to telemarketers? Have the computers installed at the "Big Eight" auditing firms. They can maintain security. Will someone stuff the

ballot box? Calling party identification will eliminate any duplicates.

The results would be provided to the legislators. Let's say that seventy-five percent of the populace said "Yes, you can raise our taxes $500 per year for national health care." Come re-election day, what would you think of the legislator who voted against the wishes of the majority? Even if you were of the minority and voted no, you would always wonder if this person was in the pocket of the American Medical Association.

Like I said, it is going to be a very interesting election.

THERE'S MORE

The Town Hall is just one application of technology that could benefit the public. While I am not in Perot's league, even a person of my humble nature can expand their thinking on how to apply technology to social problems. In doing so, many other applications come to mind. For example:

A. Americans used to dominate the car market but, today, overseas manufacturers are "cleaning our clocks."

B. The former USSR desperately needs our financial assistance and will sell almost anything to generate revenue.

C. I suspect they have quite a jump on us when it comes to small nuclear batteries. These are used in the Cosmos series satellites and generate electricity for decades.

Why not create a vehicle powered by one of these atomic sources? Just think! A car that never needs gas or recharging of the battery system; a reduced dependency on imported oil; a car that doesn't suck in air and spew out carbon monoxide and other contaminants in return. We would dominate the automobile market (for awhile, anyway).

Can it be made safe? I certainly believe so. If we can make flight recorders that consistently survive all manners of airplane crashes, we can make an atomic battery that will survive a "fender bender."

Will we ever see an atomic-powered car? I doubt it. The "no-nukes" folks have the idea that pulling up to the stoplight alongside a nuclear explosion is simply out of the question!

OBSCENITY- PART II

Speaking of explosive issues, my editorial on obscenity really touched some cords out there in ham-land. As I mentioned, a few lids feel they can enhance their self esteem by trying to shock others with their foul mouths and obscene racist jokes. Many Amateurs are trying to convince others in their families to get a "ticket." One way they do this is to show off their radios, and what one can do with them as an inducement. Often, the listener runs into one of the morons blatting away. Several people contacting NARA have indicated a lack of interest in our hobby, "if this is how hams act..." Obscenity on-the-air is completely counter productive to everything we are trying to accomplish at the National Amateur Radio Association.

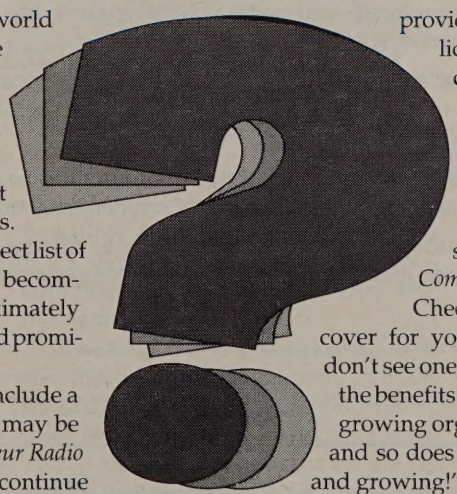
A few readers pointed out that my editorial words had a hopeless tone—that there was nothing Amateurs could do, short of guerilla warfare. I'd like to alter that impression.

Individuals can accomplish anything they set their mind to, no matter whom they are. That is one of the wonders of the human mind, regardless of what color of skin it is wrapped in. So it makes sense that groups of individuals can accomplish the same thing, if sufficiently motivated. What I overlooked is that hams *are* sufficiently motivated about this

(Continued on page 16)

HOW DID I GET THIS MAGAZINE?

One of the ways we can tell the world about the goals and ambitions of the National Amateur Radio Association is to supply complimentary copies to non-Amateurs. We send copies of each issue to hobby shops and science centers, and about 6,000 pieces to newly licensed hams. This magazine is also mailed to a select list of people who might be interested in becoming Amateurs. We also send approximately 10,000 copies to NARA members and prominent people in Amateur Radio.



If your mailing label does not include a NARA membership number, this may be your last or only copy of *The Amateur Radio Communicator*. We would like to continue providing you with this informative publication each month, but we can only do so if you are a member. For those interested in becoming a ham, or who are newly licensed, a membership in NARA represents an outstanding bargain. A membership, which includes a subscription to *The Amateur Radio Communicator*, is only $10.00 per year. Check the mailing label on the back cover for your membership number. If you don't see one, look up about six inches and read the benefits of becoming a member of this fast-growing organization. We need your support and so does ham radio. Help us get it "going and growing!"

The Clean Air Petition

PLEASE CAREFULLY READ AND FOLLOW THESE INSTRUCTIONS

1. DO NOT under any circumstances send this petition directly to the FCC. Doing so will cause them additional work, which is directly contrary to the spirit of what we're trying to accomplish, and will hurt our cause.

2. We urge you to copy this petition freely and distribute it as widely as possible. The more copies you make, and the more people you involve, the larger the number of signatures we can collect. Post it on bulletin boards in retail stores; mail copies to dealers and manufacturers with whom you do business and ask them to pass it along to their associates; pass it around at club meetings, handsets and Field Day sites.

3. Keep track of all the copies you post on bulletin boards or pass along to other people, because you'll want to get those back before the deadline for sending them to us. IF YOU DON'T DO IT, IT MIGHT NOT GET DONE!

4. Make sure that only LICENSED U.S. AMATEURS are asked to sign the petition. SIGN IN INK if at all possible; ball point pens are best.

5. The deadline for returning all petitions to us is September 1, 1992. DO NOT SEND THEM TO THE FCC! Mail all completed petitions to:

Ham Radio Business Council, Inc.
P.O. Box 5832
St. Louis, MO 63134.

6. You may call us to obtain additional information or to discuss any aspect of this petition. In California: (805) 251-5558 (Burt Hicks, WB6MQV); in Missouri: (314) 831-6464 (Walt Garrett, NØMAL); FAX (805) 251-5572.

7. We would be extremely grateful for any donations you could make to support the expense of printing, mailing and collecting the petitions. The Ham Radio Business Council is a not-for-profit corporation. Our revenue comes from membership fees and donations. We welcome your business, club or individual membership in the Council; write to us at the address above for membership information.

The Clean Air Petition is authored and coordinated by the Ham Radio Business Council, Inc., PO Box 5832, St. Louis, MO 63134.

TO THE COMMISSIONERS OF THE FEDERAL COMMUNICATIONS COMMISSION:

We the undersigned United States Amateur Radio Operators, licensed by the FCC to operate Amateur Radio stations, do hereby petition the Commission for a redress of grievances as provided for in the First Amendment to the Constitution of the United States.

The FCC is charged by Congress with regulating the Amateur Radio Service, and the FCC has formulated a set of regulations for this Service in Part 97 of the FCC's Rules.

Part 97.113(d) expressly prohibits obscene, indecent, or profane words, language, or meaning.

Part97.101(d) states: No Amateur operator shall willfully or maliciously interfere with or cause interference to any radio communications or signal.

Certain portions of the Amateur Spectra routinely suffer from violation of these rules.

The Supreme Court of the United States has ruled that in questions of obscenity and indecency, Community Standards shall apply.

We licensed Radio Amateurs are a community with the right to formulate the standards acceptable to us. As a community, we feel that obscenity, profanity, and malicious interference are repulsive to us and are therefore unacceptable offenses to our Community Standard.

Violations of these regulations hinder and impede future growth in the Service, especially among young people. Continued failure to enforce these regulations will seriously jeopardize the basis and purpose of the Amateur Service as expressed in Part 97.1 of the Rules.

The FCC has not empowered Amateurs to impose legal sanctions or penalties against violators of its Rules. Only the FCC can enforce its regulations and thereby preserve our Community Standards.

Therefore, we implore the Federal Communications Commission to reorder the priorities of those resources assigned to the Amateur Radio Service and provide swift, just, and complete enforcement of these Regulations.

Legal Signature _____ Call _____

PRINT: Full Name _____

Address _____

City _____ State _____ Zip _____

INTRODUCING!

The NARA Awards Program

MANY NEWCOMERS TO the Amateur Radio Service aren't aware of the multitude of exciting aspects of Amateur Radio that await them. Once that magical first license appears in their mail boxes from the FCC, they enter a whole new world. Shucks, most of the so-called old timers amongst us can't even keep up with the sheer vastness of it all! It's that big, you see.

In fact, there's so *much* to accomplish as a licensed radio Amateur, that it's actually a matter of picking and choosing. Do you want to sit at your keyboard and type away at a newfound friend in Tokyo? This is easily done by Amateur Radio on a daily basis. Think that cranking out data at 9600 baud, via one or more of the fifteen or so Amateur Radio satellites presently orbiting, is your cup of tea? How about serving your community and country by providing communications as part of a worldwide network of public service communicators? That's Amateur Radio for you!

Well, in addition to the exciting pursuits mentioned above, some Amateurs (*lots* of us, actually) get substantially increased pleasure out of their hobby by participating in one or more of the available Amateur Radio awards programs. We at NARA believe that the notion of chasing wallpaper, (as it's affectionately called by most Amateurs,) serves to satisfy a number of cravings that we humans seem to possess. It appeals to both the creative and competitive urges of radio Amateurs.

NARA is both proud and very pleased to introduce the *National Amateur Radio Association's Awards Program!* This unusually ambitious agenda of certificates and beautiful walnut plaques attest to the varying levels of skills and accomplishments of the Amateur Radio operator.

We should alert you in advance to the fact that these awards are *all* attainable by every class of licensee, from Novice right up through Extra. That's not to say that they'll all be simple to obtain or effortless in scope. Indeed, while a few will be designed for those Amateurs with extremely limited amounts of operating time available, others will appear to be extraordinarily difficult, possibly requiring years of effort on your part to obtain.

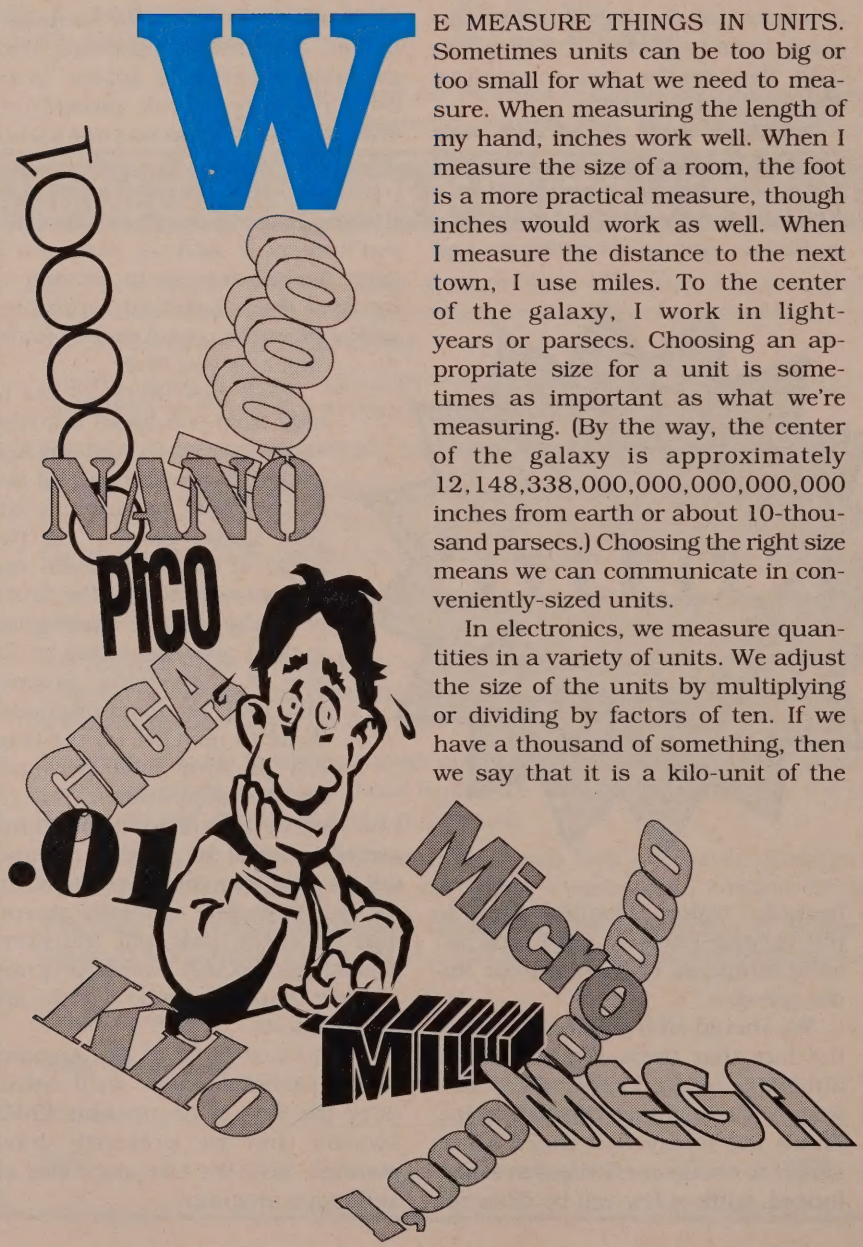
Such is the nature of a vibrant, exciting awards program! We hope you'll enjoy it, and we wish you a great deal of success in earning as many of these beautiful certificates and plaques for *your* Amateur Radio shack as you wish.

We'd most certainly like to hear from you about our new awards program. And quickly, at that! For, while we'd all *like* to think that we have our fingers firmly planted on the pulse of Amateur Radio operators worldwide, the truth is that we're very likely going to need *your* assistance in the way of suggestions, proposals, and recommendations. Write to us. Give us the benefit of your own personal awards aspirations. Tell us how easy (or how difficult) you think awards should be. And of course, tell us why you think so. Together, we can formulate mutually-acceptable decisions that will transform this fledgling NARA awards program into the Amateur Radio world's absolute finest!

In the next issue of *The Amateur Radio Communicator*, we'll introduce the first of twenty-four NARA awards that we presently have planned. See? We *told* you it was an ambitious program! ❑

Units And Unit Sizes

by Terry R. Dettmann, WX7S



WE MEASURE THINGS IN UNITS. Sometimes units can be too big or too small for what we need to measure. When measuring the length of my hand, inches work well. When I measure the size of a room, the foot is a more practical measure, though inches would work as well. When I measure the distance to the next town, I use miles. To the center of the galaxy, I work in light-years or parsecs. Choosing an appropriate size for a unit is sometimes as important as what we're measuring. (By the way, the center of the galaxy is approximately 12,148,338,000,000,000,000,000 inches from earth or about 10-thousand parsecs.) Choosing the right size means we can communicate in conveniently-sized units.

In electronics, we measure quantities in a variety of units. We adjust the size of the units by multiplying or dividing by factors of ten. If we have a thousand of something, then we say that it is a kilo-unit of the same something. When measuring frequency, 1000 hertz is the same as one kilohertz (which you will often see abbreviated as khz or KHz). The common sizings you should know are shown in Table 1.

When we work with English units, we change the type of unit at different size levels (like the foot vs. the mile, or the pound vs. the ton). In electronics, we keep the same units and simply use the common sizings to change the scale.

Let's go back to my earlier example, the distance to the center of the galaxy. An astronomer might say that it is ten kiloparsecs to the center of the galaxy. A parsec is defined in light years, light years are defined in miles, miles in feet, and feet in inches. Confusing? If we used inches, we have the figure 12,148,338,000,000,000,000,000 inches, but we can change that figure by expressing it as 12,148,338,000,000 gigainches or 12,148.338 gigagigainches. As hu-

Table 1

SIZE	FACTOR
GIGA	1,000,000,000
MEGA	1,000,000
KILO	1,000
CENTI	.01
MILLI	.001
MICRO	.000001
NANO	.000000001
PICO	.000000000001

man beings, we have an easier time relating to numbers in the range of hundreds to thousands. Larger numbers with many zeros seem unreal.

In electronics, we keep the same unit, say the unit of frequency, hertz (Hz). When we want to express many hertz, we don't change the unit, we simply change the scale! Ten kilohertz is the same as 10,000 hertz! Simple isn't it! Once you learn a few basic units like hertz for frequency, ohms for resistance, or volts for voltage, you can scale them with prefixes to deal with any size necessary.

This whole approach makes so much sense, it's a shame it wasn't thought of before we saddled ourselves with different units to measure the same thing.

Using the unit scales is easy. You simply divide the number you want to scale by the factor in the table above. Let's take the example of 10,000 Hz. I can use the kilo-scale factor by dividing by 1:

$$\frac{10{,}000\,\text{Hz}}{1{,}000} = 10\,\text{kHz}$$

If I had 10-million hertz (10,000,000), I could scale it with kilo:

$$\frac{10{,}000{,}000\,\text{Hz}}{1{,}000} = 10{,}000\,\text{kHz}$$

But I get a nicer number if I scale it with mega:

$$\frac{10{,}000{,}000\,\text{Hz}}{1{,}000{,}000} = 10\,\text{MHz}$$

or ten megahertz. If I'm measuring a capacitor, then I might find that it is a 1-microfarad capacitor. If I have the scaled value, I multiply by the scale factor to get the basic unit. So a 1-microfarad capacitor is:

$$1\mu\text{F} \times .000001 = .000001\,\text{F}$$

or 1 millionth of a farad. It's really very simple once you get the hang of it.

THE QUESTIONS PLEASE

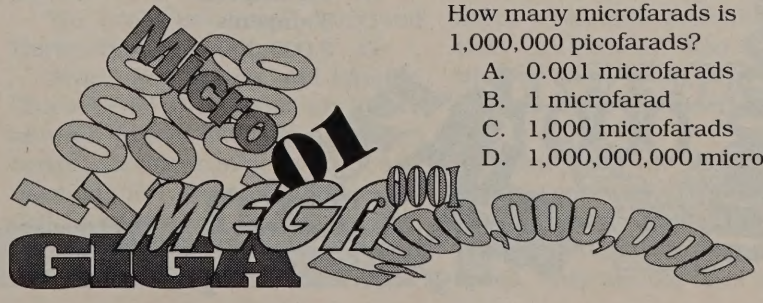
Give what you have learned a try by working through the test questions from the Technician exam:

226.
Your receiver dial is calibrated in megahertz and shows a signal at 1200 MHz. At what frequency would a dial calibrated in gigahertz show the signal?
A. 1,200,000 GHz
B. 12 GHz
C. 1.2 GHz
D. 0.0012 GHz

227.
Your receiver dial is calibrated in kilohertz and shows a signal at 7125 kHz. At what frequency would a dial calibrated in megahertz show the signal?
A. 0.007125 MHz
B. 7.125 MHz
C. 71.25 MHz
D. 7,125,000 MHz

228.
Your receiver dial is calibrated in gigahertz and shows a signal at 1.2 GHz. At what frequency would a dial calibrated in megahertz show the same signal?
A. 1.2 MHz
B. 12 MHz
C. 120 MHz
D. 1200 MHz

229.
Your receiver dial is calibrated in megahertz and shows a signal at 3.525 MHz. At what frequency would a dial calibrated in kilohertz show the signal?
A. 0.003525 kHz
B. 3525 kHz
C. 35.25 kHz
D. 3,525,000 kHz



230.
Your receiver dial is calibrated in kilohertz and shows a signal at 3725 kHz. At what frequency would a dial calibrated in hertz show the same signal?
A. 3,725 Hz
B. 3.725 Hz
C. 37.25 Hz
D. 3,725,000 Hz

231.
How long (in meters) is an antenna that is 400-centimeters long?
A. 0.0004 meters
B. 4 meters
C. 40 meters
D. 40,000 meters

232.
What reading will be displayed on a meter calibrated in amperes when it is being used to measure a 3000-milliampere current?
A. 0.003 amperes
B. 0.3 amperes
C. 3 amperes
D. 3,000,000 amperes

233.
What reading will be displayed on a meter calibrated in volts when it is being used to measure a 3500-millivolt potential?
A. 350 volts
B. 35 volts
C. 3.5 volts
D. .35 volts

234.
How many farads is 500,000 microfarads?
A. 0.0005 farads
B. 0.5 farads
C. 500 farads
D. 500,000,000 farads

235.
How many microfarads is 1,000,000 picofarads?
A. 0.001 microfarads
B. 1 microfarad
C. 1,000 microfarads
D. 1,000,000,000 microfarads

NOW FOR THE ANSWERS

226.
Your receiver dial is calibrated in megahertz and shows a signal at 1200 MHz. At what frequency would a dial calibrated in gigahertz show the signal?

A. 1,200,000 GHz
B. 12 GHz
C. 1.2 GHz
D. 0.0012 GHz

C. A giga is a thousand-million. Since the units are in millions (megahertz), we only need to divide by 1000 to get the number in gigahertz.

227.
Your receiver dial is calibrated in kilohertz and shows a signal at 7125 kHz. At what frequency would a dial calibrated in megahertz show the signal?

A. 0.007125 MHz
B. 7.125 MHz
C. 71.25 MHz
D. 7,125,000 MHz

B. Mega is a million and kilo is a thousand. To make megahertz from kilohertz, we divide by 1000.

228.
Your receiver dial is calibrated in gigahertz and shows a signal at 1.2 GHz. At what frequency would a dial calibrated in megahertz show the same signal?

A. 1.2 MHz
B. 12 MHz
C. 120 MHz
D. 1200 MHz

D. Again, giga is a thousand-million, so multiply the dial reading by 1000 to get the reading in millions or megahertz.

229.
Your receiver dial is calibrated in megahertz and shows a signal at 3.525 MHz. At what frequency would a dial calibrated in kilohertz show the signal?

A. 0.003525 kHz
B. 3525 kHz
C. 35.25 kHz
D. 3,525,000 kHz

B. A mega is a million which is the same as a thousand-thousand. To get it just in thousands (kilo), we multiply by 1000.

230.
Your receiver dial is calibrated in kilohertz and shows a signal at 3725 kHz. At what frequency would a dial calibrated in hertz show the same signal?

A. 3,725 Hz
B. 3.725 Hz
C. 37.25 Hz
D. 3,725,000 Hz

D. A kilo is a thousand, so to get it directly in hertz, we multiply by 1000.

231.
How long (in meters) is an antenna that is 400-centimeters long?

A. 0.0004 meters
B. 4 meters
C. 40 meters
D. 40,000 meters

B. There are 100 centimeters in a meter (centi means 100), so we divide by 100 to get the figure in meters.

232.
What reading will be displayed on a meter calibrated in amperes when it is being used to measure a 3000-milliampere current?

A. 0.003 amperes
B. 0.3 amperes
C. 3 amperes
D. 3,000,000 amperes

C. Milli means thousandths. Be careful not to confuse this with kilo which means thousands. A milli unit is smaller than the basic unit, while a kilo unit is larger. In this case, since we have 3000-milli units, we divide by 1000 to get the units in amperes.

233.
What reading will be displayed on a meter calibrated in volts when it is being used to measure a 3500-millivolt potential?

A. 350 volts
B. 35 volts
C. 3.5 volts
D. .35 volts

C. Again we have milli or thousandths. Dividing by 1000 gives the basic unit value.

234.
How many farads is 500,000 microfarads?

A. 0.0005 farads
B. 0.5 farads
C. 500 farads
D. 500,000,000 farads

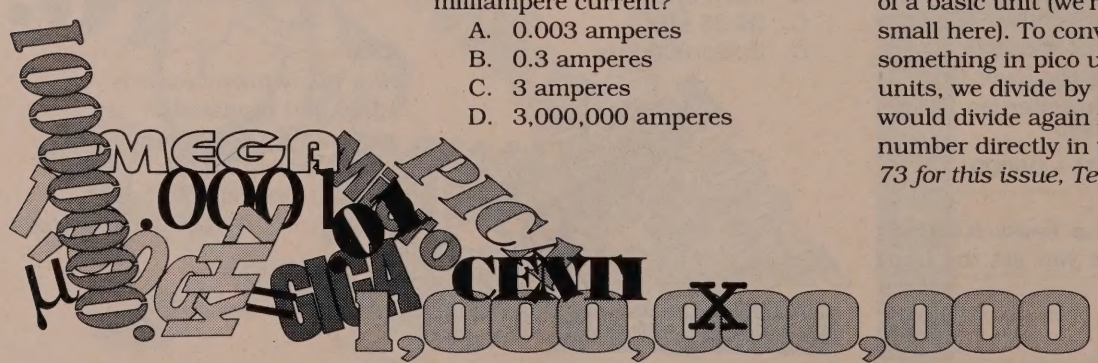
B. Micro units are millionths, 1000 times smaller than milli units. When we combine 500,000 of them together, we can divide by 1,000,000 to get the basic unit value of .5 farad.

235.
How many microfarads is 1,000,000 picofarads?

A. 0.001 microfarads
B. 1 microfarad
C. 1,000 microfarads
D. 1,000,000,000 microfarads

B. A pico unit is a millionth of a micro unit which is itself a millionth of a basic unit (we're getting pretty small here). To convert from something in pico units to micro units, we divide by 1,000,000. We would divide again if we wanted the number directly in the basic units.

73 for this issue, Terry, WX7S ❑



THE • ADVENTURES • OF

Dan & Burke

Two Tough Customers

YOU MIGHT HAVE EXpected to find Dan and Burke outside on such a wonderful, warm June evening. But they were perched on the workbench of their basement laboratory instead, looking questioningly across at their respective fathers seated side-by-side on a leather-covered couch.

"No doubt you boys are wondering why we called this conference," Mr. Bishop, Burke's father, began; "so let me say right off that you can quit looking so serious and guilty. You're not in any trouble—at least none that we've caught you in."

"That's right," Mr. Anderson agreed with a smile. "To end the suspense boys—we've decided it's time you two had a car."

"Alright!!" Dan shouted as he bounded off the bench and began jumping around the lab. Burke, who seldom permitted himself to waste any energy, stayed put; but the big grin wreathing his round face showed that he shared his friends' feelings.

"We think you should know how and why we reached this decision," Mr. Bishop continued as Dan settled back on the bench. "Both of us have kept our sharp eyes on you as you took drivers' training, as you passed your drivers' tests and got your licenses, and as you hauled the families around these past few weeks. You still have a lot to learn about handling and maintaining a car, but we think you'll learn much faster in a car for which you're solely responsible."

"I might add that your mothers don't agree," Mr. Anderson said with a wry smile; "and you should keep in mind that your old dads have stuck their collective necks way out for you on this one. If you get hurt or hurt anyone else with your car, not only will we be the two sorriest fathers in town, but we're going to hear 'I told you so' for the rest of our lives."

"Along that line," Mr. Bishop went on, "we can't have you buying a worn-out, dangerous junker. However, a good, sound used car still costs a sizable chunk of cash. Now that we're preparing to send you two through college, neither family has much money to spare—at least not enough to put out the whole cost of a good car."

"That's why we decided to split the expense and buy you two a partnership car," Mr. Anderson chimed in. "We know this arrangement wouldn't work typically, but we think you two are an exception. You practically live together anyway, so we have a hunch you won't mind sharing a car."

"No problems here!" Dan and Burke chorused.

"Fine," Mr. Bishop said happily. "Then here's the scoop: we looked around quite a bit and decided a careful shopper can get a good, safe used car for around two-thousand dollars. A careless shopper can get an awful stinging for twice that amount. At any rate, we're each putting three-hundred dollars into a car-buying fund. You boys are to shop around until you're sure you've found the car you want costing six-hundred dollars or less. Then we'll go down and buy it for you. The choice will be solely yours. We're hoping you'll take your time, use good judgment, and get a real bargain. But if you buy a lemon, there will be no one to blame but yourselves."

For a little while no one spoke. Then Burke said hoarsely, "Dad, and Mr. Anderson, I want you to know I really appreciate what you're doing. I know you're taking a chance on us, and I'm sure going to try and deserve your confidence." "Me, too," Dan added. "And maybe we can set your mind at ease on one point. Burkie and I have already talked it over, and we've decided teen-age drivers generally fall into three groups: the *Hot-Rodders*, the *Show-Offs*, and the *Grease Monkeys*.

The Hot-Rodders are the guys who try to squeeze every bit of speed and acceleration possible out of a car. They're only interested in what Amateurs would call the automobile's maximum-peak power output. A few of them fail to use good judgment about when and where they try out their 'hot wheels,' and they bring the bad name of reckless drivers to the whole group, which really isn't fair."

"Then there are the Show-Offs," Burke continued. "These guys are more concerned with the car's appearance than with its snap or top speed. They are the ones who 'trick

up' a truck or car by customizing the appearance, lowering the body, adding dual-exhausts, chrome trim, etc.... They want their 'ride' to be noticed, and sometimes they try to attract attention by squealing the tires, using straight pipes, blowing special horns, and so on."

"Finally," Dan concluded, "there are the Grease Monkeys. These are the guys who pride themselves on keeping their cars in tip-top mechanical condition and treating them with respect. Their cars are spic and span but they put no money into chrome gadgets, dummy-cellular antennas, or other 'tricks' that don't contribute to the car's performance. They would just as soon do extra homework than abuse their car's mechanism with jack-rabbit starts or tire-screeching stops. They know just as much about what makes a car tick as do the Hot-Rodders, but they're interested in the car's overall, long-time performance instead of its short-burst peak performance. They are just as proud of their cars as are the show-offs, but their satisfaction comes from a motor that purrs as smoothly and quietly as a kitten, a body that is tight and free from squeaks and rattles, and a smooth driving technique that wrings the maximum mileage out of every drop of oil or gasoline. Burko and I have decided that, as future engineers, we belong with the Grease Monkeys."

"Well," Mr. Anderson said casually, trying hard not to reveal how pleased he was with what he had just heard, "I know a pair of future Grease Monkeys who should get their sleep so they can get up bright and early tomorrow morning and start car-hunting. Come along, son; let's go home."

Late afternoon, three days later, found Dan and Burke, rather discouraged, standing in front of Sam's Used Car Sales.

"Well, we may as well go in," Dan said. "This is the very last dealer in town."

"I suppose so," Burke agreed, "but would you have believed it was so hard to buy a car? In the last three days I've been under more cars than a 'Dan-Fast' muffler, and we haven't found a thing we want at our price."

At this point a short, fat man wearing a broad-brimmed Stetson hat, big red suspenders, and puffing on a stub of a cigar sauntered out of the office of the car lot. "If you young punks are thinking of trying to sell me some hub caps you've stolen, you can forget it," he said with a scowl as he flipped the ashes from his cigar with his little finger.

"We don't want to sell you anything, sir," Dan said politely. "We want to *buy* a car."

"Not from me you don't," the big man asserted. "I've been through that jazz. You want to give me a few bucks for a clunker that will run fast enough and hold together just long enough to splash you all over the landscape. Go buy your suicide machine elsewhere. Plenty of guys will take your money."

"Now, hold on," Burke said indignantly. "We're not looking for a car to 'hot-rod.' We want a good, sound, safe used car at a reasonable price. We're more interested in how long it will run than in how fast it will go."

Sam cocked his cigar up at a jaunty angle and looked shrewdly at the two boys. "So maybe I went ballistic," he said gruffly, "but your pitch is new to me. How much dough you got?" He demanded.

Dan and Burke exchanged glances. Then Burke flung caution to the winds and gulped, "Exactly two-thousand dollars. Our dads are putting it up."

"How come your folks aren't doing the shopping?"

"They think if we've got sense enough to drive a car we ought to have sense enough to buy one."

"Hm-m-m, that's an interesting theory most folks prefer to apply in reverse," Sam said with a broad grin that crinkled his eyes almost closed. "Come along and I'll show you something."

The boys followed the waddling little man until he stopped in front of a very clean-looking Chevy sedan. "Now, there," Sam said proudly, "is a real cream-puff if I ever saw one and it's a classic. The guy who owned it had a Honda Civic that took almost all the short-trip driving. At least three-fourths of the miles on that Chevy speedometer were put on during vacations and other long trips. The rest of the time that car sat in the garage. I've been holding it for my wife's kid brother, but when he found out that the six-cylinder motor only develops 115-horse power, he lost interest. That idiot thinks anything under a couple of hundred horsepower is only for little old ladies."

Dan and Burke had been eagerly going over the car while Sam was talking. He watched them examine the brake and clutch pedals of the straight-stick job for wear. He saw them look at the mileage and date on the door-edge lube sticker and compare this with the 32,000 odd miles on the speedometer. With difficulty he concealed a grin as they solemnly ran all the door windows up and down, opened and closed all four doors, and examined the paint on the door edges for evidence of a repaint job. Then they methodically checked the tread on all four tires and carefully examined the frame for any signs that it had been heated and straightened after an accident. Finally they raised the hood and took out the dipstick. The oil was clean and of a viscosity that checked with the #20 shown on the lube sticker.

"Don't you want to hear it run?" Sam asked curiously. "That's the first thing a teenager usually does, is start the motor and wind it up before the oil has a chance to circulate. We call this 'tightening the bearings."

Sam wedged himself under the wheel and started the motor. The starter turned slowly, but once started the motor hummed smoothly.

"What's that little clicking sound?" Dan asked.

"Tappets of the overhead valves," Sam explained as he shut off the

(Continued on page 16)


Fred Maia, W5YI

National Volunteer Examiner Coordinator

The Remarkable Radio Wave

by Frederick O. Maia, W5YI

HAM RADIO HAS BEEN AROUND since the beginning of electronic communication through space—almost a century. One can only imagine the changes that will take place in the coming one-hundred years. Telegraphy by wire gave way to the invisible radio waves in 1901. The entire subject of "radio" can be pretty confusing. You have probably heard dozens of radio terms but just weren't sure what some of them meant. Let's try to simplify and explain just how those mysterious radio waves really work.

MODULATION

Early radio pioneers found that by varying the characteristics of a radio wave—frequency, amplitude, or phase—these waves could be made to communicate information of many types, including audio, video, and data. Radio waves that carry information are called radio signals, and the process of encoding intelligence onto a radio wave so that it can be transmitted over the air is called *modulation.*

The most common modulation techniques are *amplitude modulation* (AM) and *frequency modulation* (FM). The Amateur Service uses FM modulation for most of its voice contacts, although a variation of AM (called single sideband) is used at the lower-frequency levels.

During modulation, the information or message to be transmitted—a human voice, digitized data, or a television signal is impressed (modulated) onto a "carrier" radio wave that is then transmitted over the air. When a radio signal is received, the information is converted back into its original form (demodulated) by a receiver and output as sound, images or data.

> Radio waves are distinguished from each other by their frequency or their wavelength.

IS IT A FREQUENCY OR A WAVELENGTH?

Radio waves are distinguished from each other by their frequency or their wavelength. The length of a single cycle can be many miles long—to under a half-an-inch in length! Frequency represents the number of cycles a radio wave completes in one second, and is the most common description of a radio communication signal.

The international unit of frequency measurement is the *hertz* (Hz), which represents one cycle-per-second. Multiples of the hertz are indicated by the prefixes; *kilo* for one thousand, *mega* for one million, and *giga* for one billion. Thus, a million hertz (a million cycles-per-second) is expressed as one megahertz (abbreviated 1 MHz).

Radio signals can be distributed great distances through space and are identified by their wavelength. The *radio spectrum* are those frequencies that are higher than those heard by the human ear. The radio spectrum is generally considered to extend from 30 kHz to 300 GHz. While we may think that all of the radio spectrum is used up, this is really not so! The technology has just not been developed to make use of the higher microwaves. Less than one percent of the radio spectrum is being effectively used today.

Signals with long wavelengths have lower frequencies, while those at higher frequencies have shorter wavelengths. The radio spectrum is divided into bands that correspond to various groups of radio frequencies. You may identify these bands in many ways: By their frequencies, wavelengths, descriptive acronyms and their uses. Therefore, you may refer to the same band in a number of ways.

Several types of descriptive names are attached to various portions of the spectrum. One method denotes relative position in the spectrum: Very low frequency (VLF), high frequency (HF), very high frequency (VHF), and superhigh frequency (SHF). It is also common to refer to radio bands by their length in meters, such as the eleven-meter CB band, the nineteen-meter international broadcast band or the ten-meter Amateur band.

Another method derives from usage developed in World War II to keep secret the actual frequencies employed by radar and other electronic devices: Such as the L-band, S-band, and C-band. The frequency used by police radar and the detectors purchased by consumers, are usually referred to in this manner. And X–, K– and Ka-band radar detectors sound more exotic than those at five, ten or twenty gigahertz!

The ITU classifies frequencies according to band numbers—Band 1, Band 2, etc.... Frequency bands are also known by the services that use them. The AM broadcast band, the ham band, the business band, the police band, and so on. Thus the 420–450 MHz ham band is also correctly labeled as a UHF band, L-band or the 70-centimeter band.

Short wave radio, an expression first used in the 1920s, is now a meaningless term. It simply meant those wavelengths that were higher than those in use. At that time it was around three megahertz. Thus, the high frequency (HF) short waves began at three MHz. Today, even shorter microwave (another irrelevant term) frequencies up in the gigahertz range have great radio communications value. The usable wavelengths just keep getting shorter. Many Amateurs consider short wave radio to mean those high frequencies (essentially in the three– to thirty-MHz range) that are refracted back to earth from the upper atmosphere.

INTERNATIONAL REGULATION

Since radio waves do not respect international boundaries, the various nations of the world meet periodically to determine how the radio spectrum will be used. These meetings, called *World Administrative Radio Conferences* or *WARC's*, have been taking place every few years for more than 125 years. They are conducted by the ITU (International Telecommunication Union)—a United Nations agency based in Geneva, Switzerland. The ITU divides the world into three geographical areas—each with their own regional frequency allocations. North and South America are located in ITU Region Two.

Short wave radio, an expression first used in the 1920s, is now a meaningless term.

The ITU develops regulations to encourage the most efficient and interference-free use of the spectrum. It is the ITU that requires Amateur radio operators to have manual-telegraphy proficiency when their operation takes place below thirty MHz. This will undoubtedly be eliminated at the next general WARC, since telegraphy proficiency is in the process of being abolished for radio officers sailing the high seas.

General WARC's are held about every twenty years to consider all frequency allocations in the radio spectrum. Specialized WARC's cover only certain radio services and bands. A specialized WARC, which occurred earlier this year, discussed international broadcasting needs and innovative digital radio and television services.

The final accord did not change the undesirable sharing arrangement that the Amateur Service has with international broadcasting at 7 MHz. The Mexican delegation proposed that this issue should be dealt with at a future WARC that was accepted by the conference. Mexico felt quite strongly that it is desirable to have worldwide exclusive Amateur and broadcasting allocations. Thus the matter of re-alignment of the Amateur 40-meter ham band and international broadcasting at 7 MHz will be on the agenda of the next World Administrative Radio Conference considering high frequency allocations. The resolution adopted was important in that now Amateur Radio will be specifically addressed, rather than be subordinate to the needs of another service.

The allocation of radio frequencies is further refined by the various national governments involved. For example, the ITU nations agree that the twenty-meter ham band will extend from 14.000 to 14.350 MHz. But it is Part 97, Title 47 of the Communications Act of 1934, as amended and administered by the Federal Communications Commission, that determines the various operator responsibilities, restrictions and technical standards that apply to its various segments.

TRANSMISSION CHARACTERISTICS

The physical properties of radio waves determine how far radio signals can travel. The Amateur Service is allocated various bands of frequencies—each having different

propagation characteristics. Several factors affect the transmission of radio signals. All radio signals are reduced as they pass through rain or any kind of water in the air such as clouds, snow or sleet. The higher the frequency, the greater the attenuation or signal loss. This makes radio communication extremely difficult above ten GHz, especially over long distances.

Radio waves may travel from the transmitting to the receiving antenna by three kinds of paths. *Ground waves* travel along the surface of the earth, *space waves* travel through the air, and *sky waves* are returned to Earth from the upper atmosphere. The route that a radio wave takes is primarily dependent upon its frequency.

Radio waves are also bent and/or reflected as they pass through the various layers of electrified (ionized) particles of the upper atmosphere. At night some of these layers merge to greatly affect communication capabilities. This bending is called *refraction.* If atmospheric conditions are right, radio waves are also reflected in different directions from the ionosphere—the top layer of the Earth's atmosphere.

Ionospheric reflection (an extreme form of refraction) enables some radio signals to travel thousands of miles and accounts for the long-distance communication that is possible in the high-frequency band. The area between the transmitter and where the sky wave returns to Earth is known as the *Skip Zone.* The ionosphere varies in height from 50 to 200 miles above the Earth. Lower radio frequencies are more easily bent and bounced around.

Above certain frequencies, atmospheric conditions are such that there is little radio-signal refraction and reflection. The point at which this occurs is called the *Maximum Usable Frequency* (MUF) and is generally in the range of ten to fifteen MHz. It can be as high as the six-meter ham band (50 MHz) or as low as the eighty-meter ham band (3.5 MHz), depending on time of day, season, atmospheric conditions, and a curiosity known as the *Sunspot Cycle.*

Storms on the surface of the sun and their associated magnetic disturbances have a marked influence on radio communications. The intensity of these solar storms—that appear as dark spots on the sun—historically run in cycles of approximately eleven years. High sunspot activity results in longer periods of profuse ionization with increased sky-wave propagation at the higher HF frequencies. This is always good news for Amateur DX operators!

The route that a radio wave takes is primarily dependent upon its frequency.

They can carry-on international communications for a longer period of time in the fifteen-, ten- and often the six-meter band.

Below the MUF, radio signals can be used for long-distance communication by reflecting the signal off the ionosphere. Above the MUF, the signal travels straight through the atmosphere and into space. These uplinked signals are frequently captured by an orbiting satellite and retransmitted (downlinked) by an onboard radio transponder back to Earth.

At higher frequencies above the MUF, radio signals travel in a straight line-of-sight from the transmitter to the receiver. The distance a line-of-sight signal can travel is usually limited to the horizon. The higher the antenna, the farther the signal is likely to travel (since the horizon appears further away). Line-of-sight transmission requires that there be no obstacles between the transmitter and receiver. A building or mountain will block the signal. Communications in the popular two-meter ham band propagate by line-of-sight.

Since VHF/UHF signals have a limited range, their frequency may be "re-used" again by a distant station without interference. One of the basic functions of spectrum management is to locate radio stations operating on the same frequency, at specified distances from each other, to reduce interference. This is handled by Volunteer Frequency Coordinators in the Amateur Service.

Atmospheric conditions can greatly affect line-of-sight radio communications. Differences in atmospheric temperature or the amount of water in the air can cause radio signals to travel far beyond the usual line-of-sight distance. This condition is called *ducting.* At such times, signals travel for many miles beyond the horizon just as though the Earth were flat.

So there you have it! A capsule version of the characteristics of the remarkable radio wave. You can also see how different stations can operate on different wave lengths in the same geographical area at the same time, without interfering with each other. The radio spectrum is an incredibly valuable natural resource. Just think of all of its applications—microwave cooking, public safety, communication, international broadcasting, time signals, communications satellites and more! The Amateur Service is very fortunate indeed to have such wide access to its various bands.

73, Fred, W5YI ❑

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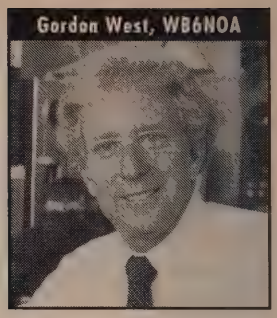
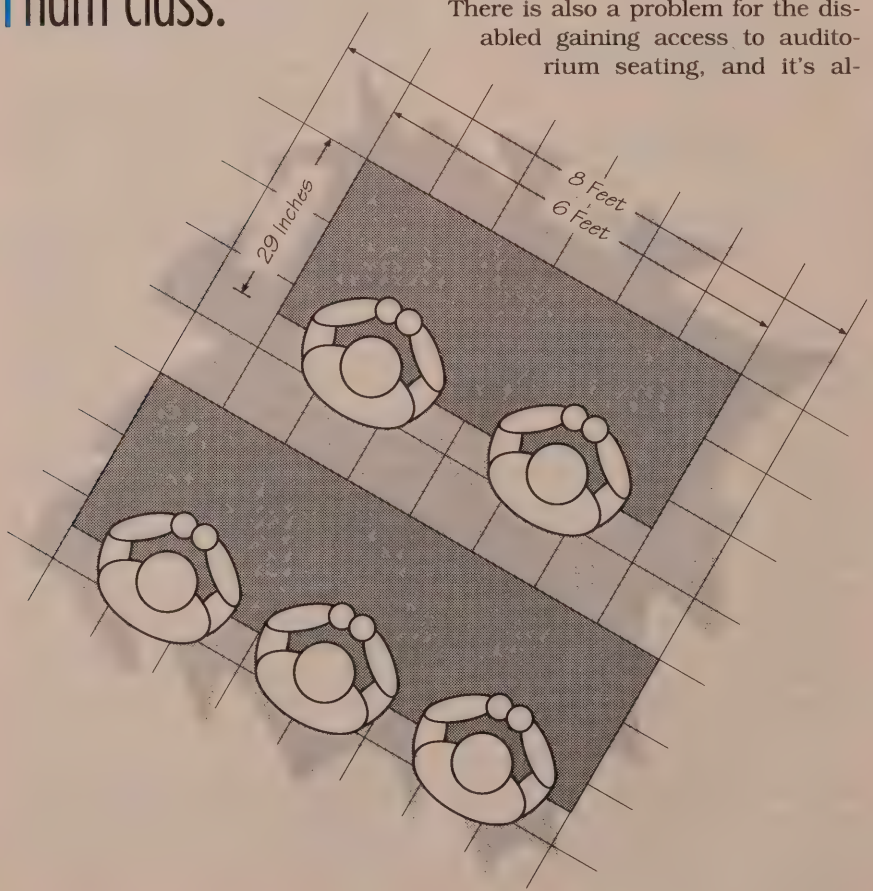

Gordon West, WB6NOA

Classroom Set-Up

by Gordon West, WB6NOA

A smooth and professional start for your ham class.

There are two styles of seating for your upcoming Amateur Radio class—auditorium-style, and classroom-style. *Auditorium-style seating is not preferred.* Your students are packed in together, and there may or may not be a folding mini-desk that pops out so that the student can write or take notes. There is also a problem for the disabled gaining access to auditorium seating, and it's always a nuisance for someone in the middle of the auditorium to have to excuse themself when everyone is still in their seats. Avoid an auditorium set-up.



Classroom-style seating is the style preferred. This is what you would ask for when booking your ham class at a local recreation hall, bank meeting room, or at a hotel conference room. Classroom seating allows for students to sit in front of a long table. This allows your students to have plenty of room to spread out their textbooks, and have equal access to the tables for the disabled. It also gives you enough "elbow room" so you can easily circulate throughout the classroom and check your students' progress.

Watch out!—There are some variations to the classroom-style that you want to avoid at all costs! Unless you are specific on the type of classroom-style seating you want, you could end up with a compromised seating situation.

For your tables, select either six– or eight-foot tables, twenty-nine-inches wide. Do not use any six– or eight-foot tables that are a skinny twenty-inches wide. Often a learning center or hotel-conference supervisor will try to squeeze in a lot more tables into a very small room by going from the regular fat tables to the abnormally skinny ones. Skinny ones are unstable, and they seldom offer enough flat area on which to really spread out. Demand the regular wide-sized, six– or eight-foot tables.

If you are using six-foot tables, put only two chairs behind them. Don't use three—three people at a six-foot table is simply too crowded. For an eight-foot table, three people is just right. If you try to squeeze in four, someone usually gets stuck halfway on the side and halfway on the end!

If you are using eight-foot tables, there should be horizontal rows of six to the right, and of six to the left, giving you combined seating of thirty-six students. You will have ample capabilities to address even the very last row of students without having to resort to a P.A. system. Thirty to forty people make up a dandy-sized ham class.

An aisle down the middle, and a fire-aisle down the sides, gives you plenty of access to monitor your students.

For a code class, try running the tables vertical to the front, and have three rows. If you use eight-foot tables, you can place three students on one side of the table, and stagger two students on the other side of the table. Wow—you now have five students on an eight-foot table with plenty of elbow room (providing you avoid the skinny tables).

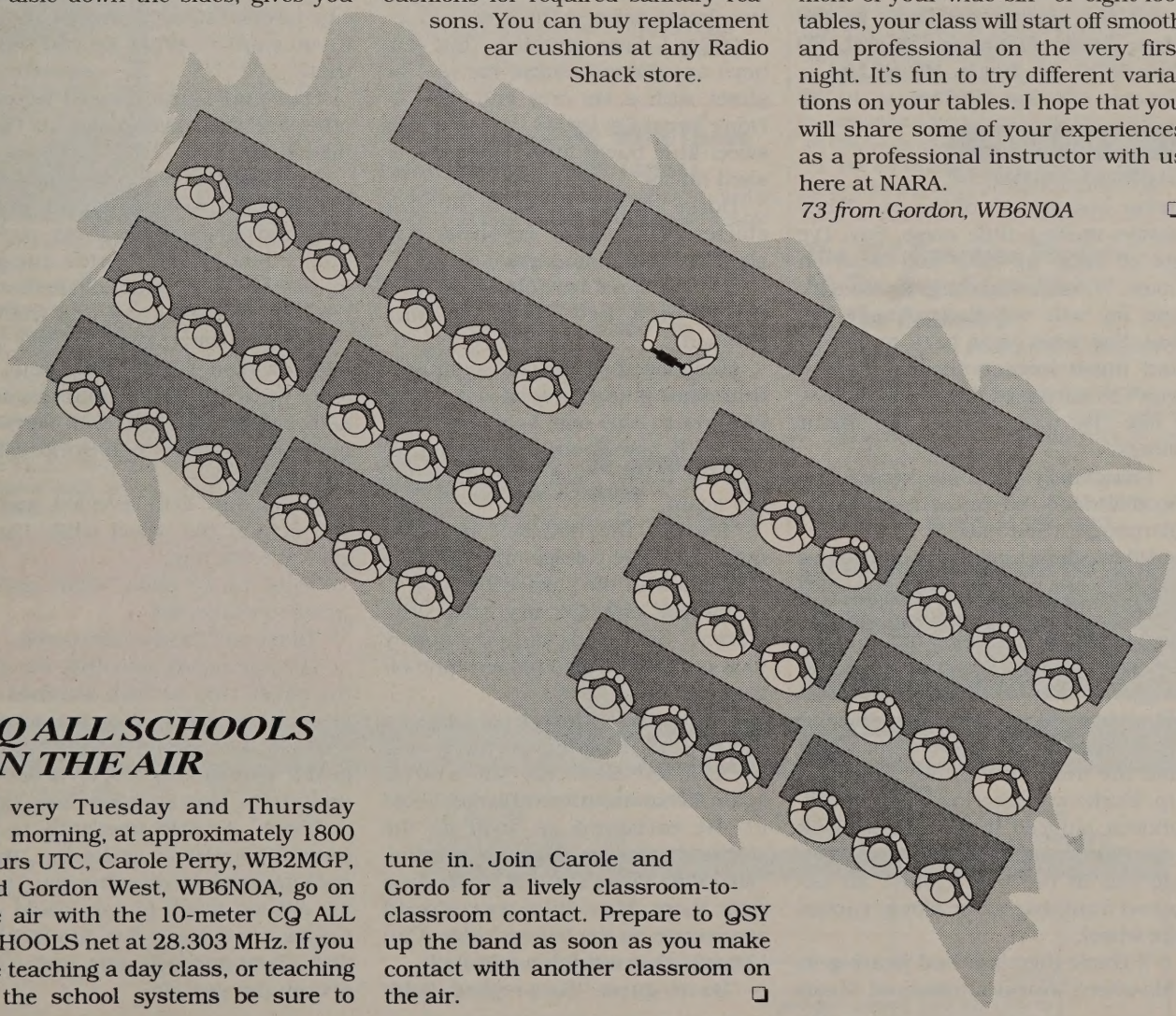
You can then run your CW headphones down the line, and have a cluster of five headsets for each eight-foot table. I also run a couple of external speakers, just in case we have a student who prefers a speaker rather than headphones. Of course, all headphones use disposable ear cushions for required sanitary reasons. You can buy replacement ear cushions at any Radio Shack store.

For the front of the room, I prefer three eight-foot tables pushed end to end. I don't use a lectern. Instead, I work with the students in front of the front table, and let them come up and play with the live radio gear during each break. Don't isolate yourself and put yourself on the back side of the front table—you lose contact with those persons struggling in the back of the room.

As you get closer to the actual examination, clear off the front table, and let your team of independent Volunteer Examiners set up their testing. In this case, you would want enough chairs in the back of the head tables for the VE's to sit and see all of the students.

If you carefully plan the placement of your wide six– or eight-foot tables, your class will start off smooth and professional on the very first night. It's fun to try different variations on your tables. I hope that you will share some of your experiences as a professional instructor with us here at NARA.

73 from Gordon, WB6NOA ❑



CQ ALL SCHOOLS ON THE AIR

Every Tuesday and Thursday morning, at approximately 1800 hours UTC, Carole Perry, WB2MGP, and Gordon West, WB6NOA, go on the air with the 10-meter CQ ALL SCHOOLS net at 28.303 MHz. If you are teaching a day class, or teaching in the school systems be sure to tune in. Join Carole and Gordo for a lively classroom-to-classroom contact. Prepare to QSY up the band as soon as you make contact with another classroom on the air. ❑

IN MY OPINION

(Continued from page 3)

issue, enough so to do something about it.

One of the most potentially successful actions has been taken by the Ham Radio Business Council, Inc. They have created a petition to the Commissioners of the Federal Communications Commission. My guess is that they will also send copies to the legislators who can do something about this dreadful situation.

I am reprinting their petition elsewhere in this issue. It is not copyrighted so feel free to make copies and distribute them anywhere hams congregate. ***DO NOT*** send the petitions to us or to the FCC. Rather, ***mail the signed petitions to the Ham Radio Business Council, PO Box 5832, St. Louis, MO 63134.***

For now, 73, Don, W6TNS ❑

DAN AND BURKE

(Continued from page 10)

motor and got out of the car. "They always make a little noise. Say, I've got to close up now and head on home. We're having company tonight, and my wife will flatten me if I'm late. You boys come back tomorrow and finish looking the car over. I won't be surprised if we do business. I like the way you two go about things."

Reluctantly the boys closed the hood and took off for home, excitedly planning further checks.

When Sam unlocked the door of his office the next morning, Dan and Burke were right on his heels. He had to do some book work, but he gave the boys the keys to the car and suggested they take it for a trial drive. When he walked out of the office an hour later, the boys were back and had the front end of the car jacked up. Burke was wearing a pair of earphones plugged into a small black box. He was pressing a little rod sticking out of the box against an exposed front axle as he slowly turned the wheel.

"I think there's a bad bearing in this wheel," Burke announced. "I can hear it grinding through this contact mic connected to this transistor amplifier. I don't hear it on the other wheel."

"We'll soon find out," Sam said indulgently as he pulled a crescent wrench and a pair of pliers from his hip pocket and started taking off the wheel. "I was a garage mechanic for many years," he explained, "but they kept making cars lower and lower, and I kept getting thicker and thicker. Finally, even with lowering blocks on my creeper, I couldn't slide under them anymore; so I stopped doctoring them and started selling them. Well! I'll be darned! This bearing is a little rough. We'll put in a new one."

"And how about relining the brakes?" Dan asked. "Those bands are almost down to the iron."

"Okay," Sam groaned, "but you boys are going to have me on the street with a tin cup and pencils. Don't forget I'm letting you steal this sweet-little buggy for only two-thousand bucks."

Burke got into the car and hit the starter. The motor revolved very slowly but did not start.

"Don't tell me I'm going to have to throw in a new battery!" Sam groaned.

Dan picked up the volt-ohmmeter that had been placed for safekeeping in the rear seat and connected it across the battery terminals as Burke twisted the starting key again.

"It's not the battery," Dan announced. "The voltage only drops to 5.5 volts with the starter load."

"Better the battery than the starter," Sam said, as he nervously took out one of his crooked little cigars and lit it.

"I've hooked the meter between the grounded battery terminal and the starter case. Hit the starter again," Dan instructed Burke. "Hold it!" He exclaimed as soon as the starter began its sluggish turning. "That's it. There's a volt or so drop right there. Must be a poor ground connection on the battery cable. Can I borrow that wrench a minute?

"Be my guest," Sam replied, holding out the tool.

Dan's lanky frame slid easily under the car, and he did some high-powered grunting and wrench-tugging. "Now try it," he called. The starter whirred rapidly, and the motor started instantly.

A pleased smile spread over Sam's face. "Boys," he said impulsively, "I've taken a shine to you so let's quit horsing around. I like to see a good car go to someone who appreciates and takes care of it. You two have convinced me you will do just that. I'll stake my reputation as a mechanic—of which I'm pretty proud—that this car will give years of satisfaction. It's a real bargain at two 'big ones' just as it stands, but I'll put in the new bearing and the brakes and check it all over. You can have it at eight o'clock tonight if you want it. What do you say to that?"

Dan and Burke looked at each other and then said in chorus, "We'll take it!"

It seemed to the boys that eight o'clock would never come, but finally they and their fathers drove over to Sam's place. Their pride-and-joy, freshly washed and polished, was ready and waiting right in front of the office. They looked it over lovingly as their fathers went into the office with Sam to conclude the deal. As the men came out, Dan flipped a quarter into the air and Burke called out, "heads!"

"Tails it is," Dan revealed, and he slid behind the wheel while Burke got in beside him.

"Pilot to co-pilot," Dan called, "ready for take-off!"

"Blast-off," Burke instructed.

The car rolled smoothly out into the street, and as Sam watched the gleaming tail lights disappear around a corner, he took off his big hat and held it against his chest as he looked up into the star-studded June sky.

"Boss," he said reverently to the powerful mechanic in the sky, "there goes my good deed for the day. But if it's not too much to ask, could you maybe send me a few tire-kicking, door-slamming fools now, just to sort of even things up?" ❑

AVAILABLE FROM NARA

The Ham Radio Handbook

by Donald L. Stoner, W6TNS, is the leading book for anyone wishing to earn the new code-free Technician license. Includes every question you might be asked during a test session, plus the multiple-choice answers.

The Ham Radio Handbook is the only test manual that explains in detail why the correct answer is correct. Includes simple and easy-to-understand theory along with many photos and illustrations.There are ten chapters covering each subelement. The appropriate test questions and answers are given at the end of each chapter. The list of correct answers is included at the end of the book. Guaranteed to provide all the information needed to get your ham radio license or your money will be refunded. ***The Ham Radio Handbook*** is only **$9.95 ($2.00 S&H)** #B610.

The Rules of The Road

It took the Federal Communications Commission nearly two years to completely overhaul the Amateur Radio Service Rules to reflect current technology and Amateur operations. The FCC also deleted many unnecessary, obsolete, and redundant rule provisions.

The new rules have now been totally reorganized and revised into Part 97 of Title 47 CFR (Code of Federal Regulations) which covers all rules and regulations governing the Amateur Radio Service. Learn about the guidelines for emergency communications, required equipment standards, operator responsibilities and restrictions, and much more. Over 60 pages of information—a must for every Amateur to have in the ham shack. ***Rules and Regulations, Part 97, Amateur Radio Service*** is only **$4.95 ($1.00 S&H)** #B640.

Order Today!

UPGRADE! Shows You How Easy It Is To Upgrade!

UPGRADE!, a new book by Donald L. Stoner, W6TNS, that shows "no-code" hams how easy it is to upgrade to the Tech-Plus or General Class license.

UPGRADE! was written to encourage learning, rather than memorization. There are nine chapters covering each subelement of the General Class exam. All multiple-choice questions and answers for the General Class exam are included. Every chapter provides you with simple-to-understand discussions explaining the theory behind each exam question.

UPGRADE! also contains a chapter describing the different Amateur Radio license classes, descriptions of the Elements (tests) which must be passed to move to a higher license class, and an extensive history of Morse code. Fred Maia, W5YI, and Gordon West, WB6NOA, provide their favorite tips on learning Morse code to help you avoid the dreaded "speed plateau" at 8 to 9 words-per-minute.

UPGRADE! is available from all major Amateur Radio equipment stores, or you can order direct from NARA for only **$9.95 ($2.00 S&H)** #B620.

Practice The Code With These Outstanding Code Tapes!

These tapes will help give you the practice you need to pass your code exams. Each set contains two cassette tapes.

- Novice/Technician goes to 5 words-per-minute to prepare you for Element 1(A) #T710.
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- Extra will take you from 12 to 24 words-per-minute to prepare you for Element 1(C) #T730.

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Back Issues of *The Amateur Radio Communicator*

Back issues of *The Amateur Radio Communicator* are still available.

- Volume 1, Issue 1 (in very short supply) is **$5.00 ($1.00 S&H)** #K809.
- All other issues are **$2.00 ($1.00 S&H)** #K810.

ATV Secrets For Aspiring ATV'ers

ATV Secrets For Aspiring ATV'ers, written by Henry Ruh, KB9FO, contains every-thing you wanted to know about Amateur Television (ATV). All ham licensees can participate in ATV—*even those with the new no-code license!* Amateur TV is fun and exciting. Take your home video productions and find new audiences, make new friends and get more enjoyment from your equipment. Hams should be *seen* as well as heard!

ATV Secrets is available through all major Amateur Radio equipment stores, or you can order from NARA for only **$9.98 ($2.00 S&H)** #B630.

The Flight Of OSCAR One— A True Collectors Item!

The first OSCAR satellite was little more than an orbiting shoe-box. But it carried aloft far more than just a keyer and transmitter—it also held the dreams of Amateurs everywhere for a new era in communications. Today, we enjoy worldwide contacts via sophisticated OSCARs orbiting tens-of-thousands of kilometers above the earth. Relive the launch of OSCAR One from Vandenberg Air Force Base—hear the excitement of the dedicated hams who operated the OSCAR net and listen to its greeting message, "HI," as it whirled around the globe in 1961. This historic recording is only **$6.95 ($1.50 S&H)** #T700.

The FCC Question Pools— All The Questions And All The Answers

Each booklet contains all the questions and answers for each license class. Does not contain any explanations. Order your booklet by license class.

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The goals of NARA are to:

- Get more people licensed in the Amateur Service.
- Get more young people interested in Amateur Radio.
- Save the various Amateur bands (frequency ranges) from confiscation by commercial interests.
- More recognition for the Amateur Radio Service.

In the past year, Amateur Radio has lost part of the 220-MHz band and, in some areas of the country, is in the process of *losing access* to another band (900 MHz).

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